

INCENTIVE POLICIES FOR COAL PLANTS IN TURKEY

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Turkey need for electricity increases constantly because of its developing economy. So it applies to incentives to find solution to the problem of scarcity of electricity. Building plants using coal gets the greatest support from the state in Turkey. Electricity production with coal in Turkey increases faster than the other sources due to the incentive policies at place. On the other hand, coal compared with other fossil fuel is also the most abundant and most widely used fossil fuel in the world. According to the International Energy Agency data, building plants using coal is in the lead. In addition, it is foreseen that building plants using coal will be the major way of producing electricity although many other materials started to be used in the production of electricity. The aim of this study is to evaluate the incentive policies Turkey has in regards to coal plants and to offer policies.

Key words: Turkey, coal, incentive policy, electricity generation

Introduction

Countries apply different incentive policies to ensure sustainability in energy supply security. Incentive policies of countries are the most important factor determining which kind of material is used most widely in electricity production. The size of electricity production and choice of source of energy which gives more electricity is shaped by incentive policies implemented by policy makers. In addition many researchers stated that incentive policies implemented by policy makers affect power generation [1-7].

Countries shape their incentive policies according to energy resource potentials. Turkey applies incentive policy to increase power generation of domestic energy resources. The most abundant source in Turkey is coal compared to other fossil resources. Turkey has mostly lignite and then hard coal. Turkey applies important incentive policy to achieve maximum level of power generation from coal plants especially because of lignite reserves. Subsidies provided to the coal-based electricity plants in question are many more than subsidies provided to other energy sources. Subsidies given to the coal-based power generation are much more than also subsidies to renewable energy sources (RES).

Coal is the most widely used fossil source in the world. Coal plants are the most important part of the world's electricity supply because a large part of electricity of the world is generated through burning coal. According to the International Energy Agency (IEA) data, while power and heat generation with coal was 22.3% Exajoules ($EJ = 10^{19}$) in 1971, it increased to 97.8 EJ in 2013 after 40 years [8]. In addition, more than 40% of the world's power generation is provided with coal [9]. As it is understood, despite RES and the threat of global warming, the world's most of electricity is and will be generated in coal-based power plants.

On the other hand, Turkey participated in the United Nations framework convention on climate change on May 24, 2004. Turkey also became a party to the Kyoto Protocol on the United Nations framework convention on climate change No. 5386 on August 26, 2009 [10]. In addition, Turkey has signed the Paris Climate Treaty, which aims to combat climate change. Turkey has submitted the national contribution declaration to the United Nations Secretariat under the Paris Climate Treaty. Turkey has pledged to reduce its GHG emissions by 21% between 2020 and 2030 in its national contribution statements [11, 12]. However, in order to reduce the release of CO₂ and protect the environment in Turkey by many researchers. Turkey's should abandon fossil energy sources, such as coal, which emit high GHG emissions, and turn RES that do not cause GHG emissions [13-16].

In this manuscript, in the scope of Turkey's energy security, the strategic plan for the coal based electricity generation and promotion policies have been investigated and discussed. Moreover, the actual case and challenges of the coal based electricity generation in Turkey have been analysed. Finally, some recommendations have been given to policy makers for sustainable coal based electricity generation in Turkey's demand of electricity production.

World electricity generation and coal

Electricity generated in the world will increase to 39.0 billion kWh in 2040 according to a report released by US Information Administration (EIA) [17]. The amount of electricity generated in the world between the years 2010-2040 is given in tab. 1. According to this table, it is seen that most of electricity of the world between the years 2010-2040 will be generated with coal. In addition, power generation based on coal will increase year by year. The same table depicts that natural gas follows power generation based on coal.

Table 1. World net electricity generation by energy source, 2010-2040 (trillion kWh) [17]

World	2010	2015	2020	2025	2030	2035	2040	Average annual percent change 2010-2040
Liquids	0.9	0.9	0.8	0.8	0.7	0.7	0.7	-1.0
Natural gas	4.5	5.0	5.5	6.2	7.2	8.3	9.4	2.5
Coal	8.1	9.2	10.1	11.3	12.3	13.2	13.9	1.8
Nuclear	2.6	2.9	3.6	4.3	4.8	5.1	5.5	2.5
Renewables	4.2	5.3	6.5	7.2	7.9	8.8	9.6	2.8

According to data provided by IEA, about 40% of electricity of the world is generated by China and the USA. Besides the country having the biggest capacity of power generation is China. The USA follows China [18]. Coal has the biggest share in power generation in China [19, 20]. Coal has the biggest share in power generation also in the USA [21, 22]. The other countries generating electricity mostly through coal source are India [23], South Africa [9], Brazil [9], and Germany [24]. In Turkey, coal-based electricity generation does

not have the largest share. But the share of coal-based electricity production in Turkey is constantly increasing.

View of power generation of turkey

Electricity generation and installed power according to sources are given in tab. 2 and fig. 1, respectively. As shown in tab. 2, by the end of 2015 the rate of electricity generation Turkey produces through thermic power plants is 68.52% of total electricity generation. While power plants based on natural gas + liquefied natural gas (LNG) takes place on the top with its

37.9% rate, power plants based on coal follows them with 29.09% rate. Hydraulic follows thermic power plants with 25.6% rate [25].

Table 2. Distribution of Turkey electricity generation by primary energy source (GWh) [25]

Primary energy sources		2014		2015	
		Electricity generation [GWh]	Total production rate [%]	Electricity generation [GWh]	Total production rate [%]
Coal	Hard coal + import coal + asphaltite	39647	15.7	44830	17.12
	Lignite	36615	14.50	31336	11.97
	Sum	76262	30.2	76166	29.09
Liquid fuels	Fuel-oil	1663	0.66	980	0.37
	Diesel fuel	482	0.19	1244	0.48
	Sum	2145	0.85	2224	0.85
Natural gas + LNG		120576	47.9	99219	37.9
Renewable + waste		1453	0.57	1758	0.67
Thermic sum		200417	79.5	179366	68.52
Hydraulic sum		40645	16.1	67146	25.6
Wind sum		8520	3.4	11652	4.45
Geothermal sum		2364	0.9	3424	1.31
Sun sum		17.4	0.01	194	0.07
Grand total		251963	100	261783	100

Looking at fig. 1, in 2015, the installed power in Turkey's electricity generation is 73146.7 MW. Most of the installed power is hydraulic (25867.8 MW) and natural gas (21258.1 MW). Coal-fired thermal power plants are coming after. Electricity generation from natural gas, hydraulic and coal accounts for about 90% of the total production of Turkey. The share of other energy sources in Turkey's electricity generation is small. This situation is a negative situation in terms of Turkey's energy supply security. As a result, Turkey should increase the share of other energy sources for electricity generation, excluding natural gas, hydropower, and coal-based energy sources. In addition, electricity generation rate of Turkey is about 70% with carbon-based energy sources such as natural gas and coal. This rate is very high in terms of Turkey's carbon emissions. Because Turkey has to reduce its electricity production with carbon-based energy sources such as natural gas and coal in order to fulfill its commitments under climate agreements.

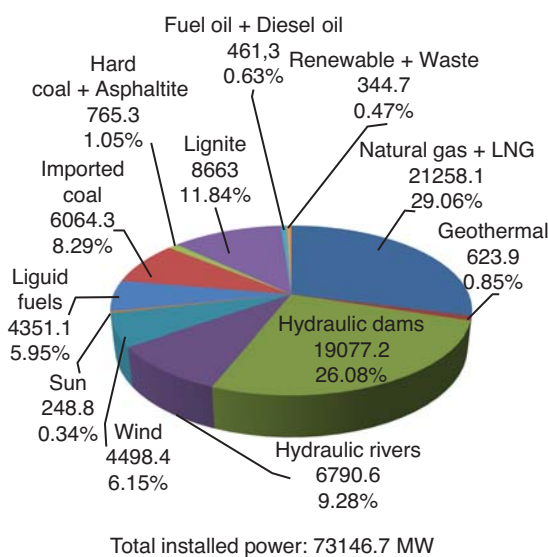


Figure 1. Distribution of Turkey electrical installed power according to sources, in 2015 [26]

Strategic plan of Turkey for power generation based on coal

Turkey has issued *Document of Strategy Electric Power and Market and Supply Security* dated May 18, 2009 and numbered 2009-11 by the Prime Ministry State Planning Organization Supreme Planning Council [30]. To increase the share of domestic sources has been identified as a priority target in the document in question. Therefore, it is stated in Turkey that all of the known sources of lignite and hard coal will be used for power generation.

Moreover, Turkey's Energy and Natural Resources Ministry has prepared a five year strategy plan for energy [31]. The strategic plan covers the strategies of Turkey in energy politics as well as its initiatives and it is a reference supporting to national economical aims. In this strategic plan, to evaluate domestic coal reserves of Turkey in the most effective way is identified as one of the main targets. In addition, increasing lignite and hard coal production is aimed. Power generation with domestic coal plan of Turkey, which is stated in the strategic plan, between the years of 2015-2019 is given in tab. 4. The table represents that reaching annual production level of 60 billion kWh in power generation with domestic resources is a target set to be achieved by the end of 2019. As a result, Turkey intends to increase domestic coal-based electricity production with the national strategy plan.

Table 4. Power generation based on domestic coal plan of Turkey between the years of 2015-2019 [31]

Amount of power generation based on domestic coal (billion kWh)	Base year 2013	2015	2017	2019
	32.9	40	50	60

From the other side, Turkey has been aiming to reduce the electricity production from imported natural gas with the strategy plan and to increase the electricity production from RES. This will increase both domestic coal-based electricity generation and renewable energy-based electricity generation. Nevertheless, the strategy plan did not include targets for reducing imported coal-based electricity generation. For this reason, imported coal-supported electricity production in Turkey will increase more. In this case, it will adversely affect Turkey's energy supply security.

Power generation based on coal incentives

Turkey has begun to give greater importance to the domestic resources used in power generation. Important incentives are given to especially coal plants. Coal plants are given more incentives than other electricity generation sources in tab. 5. Turkey is divided into six regions with regional investment incentives applications implemented by Ministry of Economy. The regions are divided according to their economic development. The sixth 6th is the one which is supported most.

Furthermore, power generation based on coal investments are included among the priority investment issues with the decision numbered 2013/4288 of Council of Ministers which is announced in Official Newspaper dated February 15, 2013 and numbered 28560. Thus, the 5th region incentive will be provided for all power generation based on coal investment without taking into account the regions. The incentives provided in the 5th region: Customs duty exemption, vat exemption, tax reduction, support for employer share of insurance premiums, investment allocation, the interest subsidy. In the case of making power generation based on coal investment in the 6th region, the support of income tax withholding and insurance premiums will be provided, too [35]. Thus, the investors investing in power generation through coal burning are getting significant financial support from the state.

Table 5. Support and incentives according to the sources of electricity in Turkey

Power supply	Purchase guarantee (US\$ per kWh)	Warranty period (years)
Sinop NPP [32]	11.83	20
Akkuyu NPP [33]	12.35	15
Hydroelectric [34]	7.3	10
Wind [34]	7.3	10
Sun [34]	13.3	10
Biomass (garbage gas) [34]	13.3	10
Geothermal [34]	10.5	10
Domestic coal [35] 5 th region incentive:	VAT exemption Customs duty exemption Tax reduction 40-60% Support for employer share of insurance premiums: 7-10 years Investment allocation Interest support: 2-5 points	

On the other hand, the incentives given to RES in Turkey are very low compared to European countries [36]. Turkey promotes electricity generation with RES within the framework of the mechanism for supporting RES. Within scope of incentive the purchase guarantee price per kWh applied, 7.3 cents for wind and hydroelectric power plants, 10.5 cents for geothermal, 13.3 cents for biomass and sun. In addition to these figures, additions varying between 0.4-3.5 cents are made depending on the use of domestic equipment [34]. As can be seen in tab. 6, the incentives given to RES in Turkey are very low compared to the domestic coal mine. This situation will adversely affect the development of RES in Turkey. In addition, the low level of incentives given to RES will adversely affect Turkey's efforts towards climate politics.

Work has been started to establish two nuclear power plants (NPP) in Turkey. The first of the NPP, Akkuyu will be built in Mersin, Turkey with the intergovernmental agreement with Russia. The second one is the NPP to be established in Sinop, Turkey under the treaty between Turkey and Japan. Turkey's incentive model for both NPP is based on long-term (20 and 15 years) and price purchase guarantees as shown in tab. 6. The NPP to be established in Turkey will enable diversification of energy sources in electricity generation. In addition, the NPP to be installed will contribute positively to the rapidly increasing energy demand of Turkey.

Conclusion and policy implications

In recent years, Turkey has started to focus on domestic resources for the sustainable electricity production due to its dependence on natural gas in electricity production. Especially for coal power plants are given big incentives. The incentives in question given to coal power plants are much bigger than the ones for other resources of electricity production. In addition to this, Turkey has the biggest potential in coal resources among fossil fuels, so it should be evaluated as the *primary source*. Turkey should plan especially new power plants based on lignite for sustainable energy and continue the exploration of lignite. Therefore, Turkey should develop new policies in order to increase the share of coal in electricity production, to reduce the foreign dependency and to provide the security of energy. Moreover, by doing so, Turkey will create a good amount of jobs, and increase the coal production and new ways of power production will be introduced.

On the other hand, Turkey's incentive for generating electricity with domestic coal is much higher than RES. This situation will limit the development of electricity production with RES in Turkey. Turkey's great incentives for electricity generation with domestic coal are

contradictory to climate change agreements. Because Turkey declares that it will reduce carbon emissions through climate change treaties, while the other side provides great incentives for carbon-based domestic coal-based electricity generation. However, Turkey has a slightly higher carbon intensity than developed countries [37]. As a result, Turkey should raise the incentives for RES to the level of incentives for coal-based electricity generation. In addition, Turkey must provide clean coal technology for coal-fired thermal power plants. Clean coal technology applications reduce carbon emissions from coal-fired thermal power plants and make coal-fired thermal power plants work more efficiently.

Among coal reserves, Turkey has a lot of lignite reserves in good condition but it has limited hard coal reserves. However, the hard coal-fired power plants are much more effective than lignite-fired ones. The electricity produced in hard coal-fired power plants is much more than the lignite-fired power plants with same amount of coal because the calorific value of hard coal is much better than lignite. Turkey may increase the calorific value of lignite by focusing upon research and development activities intended for improvement (coal combustion technologies) of lignite coal. In addition, Turkey needs to make it compulsory that new power plants should be based on lignite. Because of the fact that Turkey has insufficient reserves of hard coal, it will be imported for hard-coal fired power plants. This condition will be problem for the sustainable electricity production.

Almost all of the natural gas used in Turkey's gas-powered electricity production is imported. Nevertheless, there is a continuous increase in the production of imported coal-supported electricity in Turkey. This situation has led Turkey to become a country dependent on imports of electricity. Turkey supplies about 50% of total electricity production with imports. Feeding Turkey's electricity production with imported energy sources such as natural gas and coal will cause problems in Turkey's energy supply and at the same time increase the current deficit in foreign trade. Therefore, in order to reduce the amount of imported resources such as coal and natural gas used in electricity generation in Turkey, it is necessary to set a limit with additional taxation methods. This will ensure that electricity generation with domestic coal will develop further. Moreover, reducing import dependency in Turkey's electricity generation will reduce the weight of fossil fuels in electricity generation. Thus, the share of renewable energy resources in electricity generation will be increased.

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